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1	1	QA ~~D. G. Farwick~~ T.L. Benning	T.L. Benning	7/28/92	H4-16						
1	1	Safety F. A. Schmorde	F. Schmorde	7/28/92	H4-57						
		Env. L. P. Diediker	L. Diediker	08/26/92	T1-30						
		SA&R N. R. Kerr	N R Kerr	7/28/92	N1-75						
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6. Author

Name: D.L. Harrold

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Signature

Organization/Charge Code 29550/PB3JA

7. Abstract

This is the safety assessment for the proposed helium tracer gas leak test to be performed on three underground pipelines in the 200-BP-1 operable unit.

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CONTENTS

1.0 INTRODUCTION AND SUMMARY

The U.S. Environmental Protection Agency has proposed that the 200 Areas at the Hanford Site be included on the National Priorities List under the Comprehensive Environmental Response, Compensation and Liability Act of 1980. In response, the U.S. Department of Energy, Richland Field Office developed a work plan for the 200-BP-1 Operable Unit. This plan, titled the *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-1 Operable Unit, Hanford Site, Richland, Washington* identifies investigative tasks that will provide information on the nature and extent of contamination within the operable unit (DOE-RL 1990).

Task 3 of this plan consists of surface and near surface soil sampling and analyses within the 200-BP-1 Phase I Remedial Investigation. Helium tracer gas leak detection will be performed on three underground pipelines in support of Task 3. The purpose of this document is to assess the hazards associated with the leak test. The hazard inventories in the pipes consist of the residues left behind from waste transfer activities. The underground pipelines to be leak tested (see Figure 1) are described below:

- Two 4 in. (10 cm) lines that run the length (east and west) of the 241-BY Tank Farm approximately 500 ft (152 m) long. The lines were used to transfer waste from the BX/BY Tank Farm to the BC cribs and trenches outside the operable unit (OU).

- A 2 in. (5 cm) dia pipe approximately 200 ft (61 m) long that runs north, northwest, and then north again to the vicinity of the 216-B-43 through 216-B-50 Cribs. This pipe transferred condensates from the tank farm to the cribs.

Two other pipelines that may be tested are described below and shown in Figure 1. These two lines are expected to contain little or no contamination in their interiors. Any hazard consequences resulting from leak testing these pipes will be bounded by the analysis for the pipes mentioned above.

- A 2 in. (5 cm) dia pipe that runs east and west 125 ft (38 m) from and parallel to the north boundary to the vicinity of the concrete pads just northeast of the 216-B-46 crib [approximately 500 ft (152 m)] long.

- The underground pipeline that runs north, northwest, and then west from the 241-BY Tank Farm fill area to the 216-13-61 crib [approximately 590 ft (180 m) long]. Although it may have never been used, the purpose of this line was to transfer condensates from the tank farm to the crib.

Liquid wastes disposed at the 200-BP-1 Operable Unit cribs and unplanned releases were the result of the tributyl phosphate or in-tank solidification (ITS) processes associated with single-shell tank farm operations. The waste was scavenged by potassium ferrocyanide to precipitate cesium. The supernatant was decanted to cribs in the OU. The ITS process heated tank waste and in the process, generated condensates. These condensates were also disposed of in cribs at the 200-BP-1 Operable Unit.

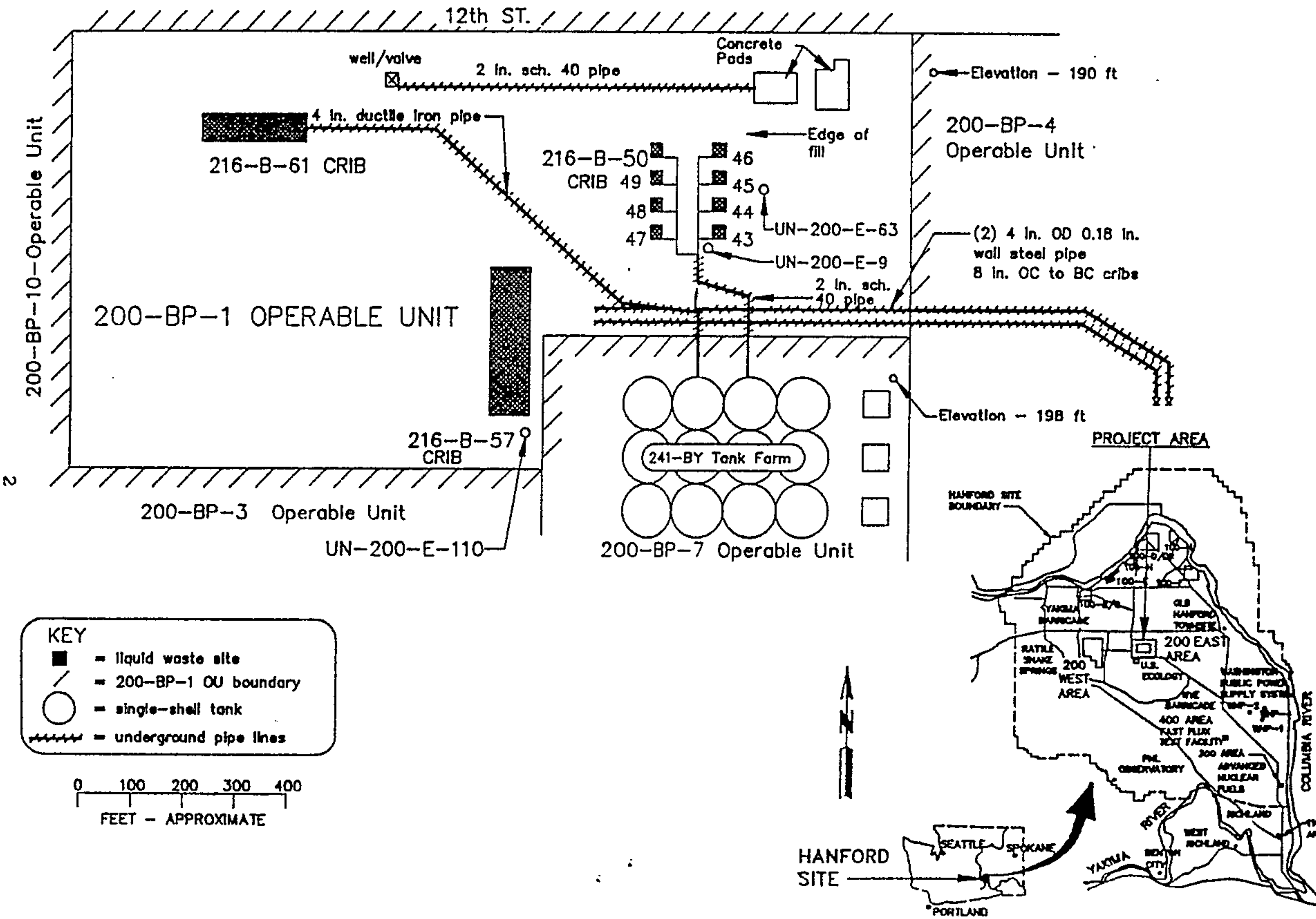


Figure 1. 200-BP-1 Operable Unit and Vicinity Map.

This safety assessment satisfies the requirements of Westinghouse Hanford Company (WHC 1988b) and DOE 5481.1B, *Safety Analysis and Review System*, dated 9/23/86.

1.1 ASSESSMENT SUMMARY

A postulated accident involving a pressurized release of the pipe residues was evaluated for hazard consequences. Based on the assumptions made in the accident scenario, the dose consequence to the uninvolved individual was found to be < 1E-6 rem. The dose consequence to the facility worker was found to be < 1E-3 rem. A radiation survey of the pipes indicates that general area dose rates are approximately 15 mrem/h. This means that a worker standing in the 15 mrem/h field for 4 min would receive a dose comparable to the 1E-3 rem (1 mrem) inhaled dose resulting from the postulated accident. The results of the assessment show the helium leak test on the three pipelines to be a low hazard activity.

1.2 SUMMARY OF CONTROLS AND LIMITS

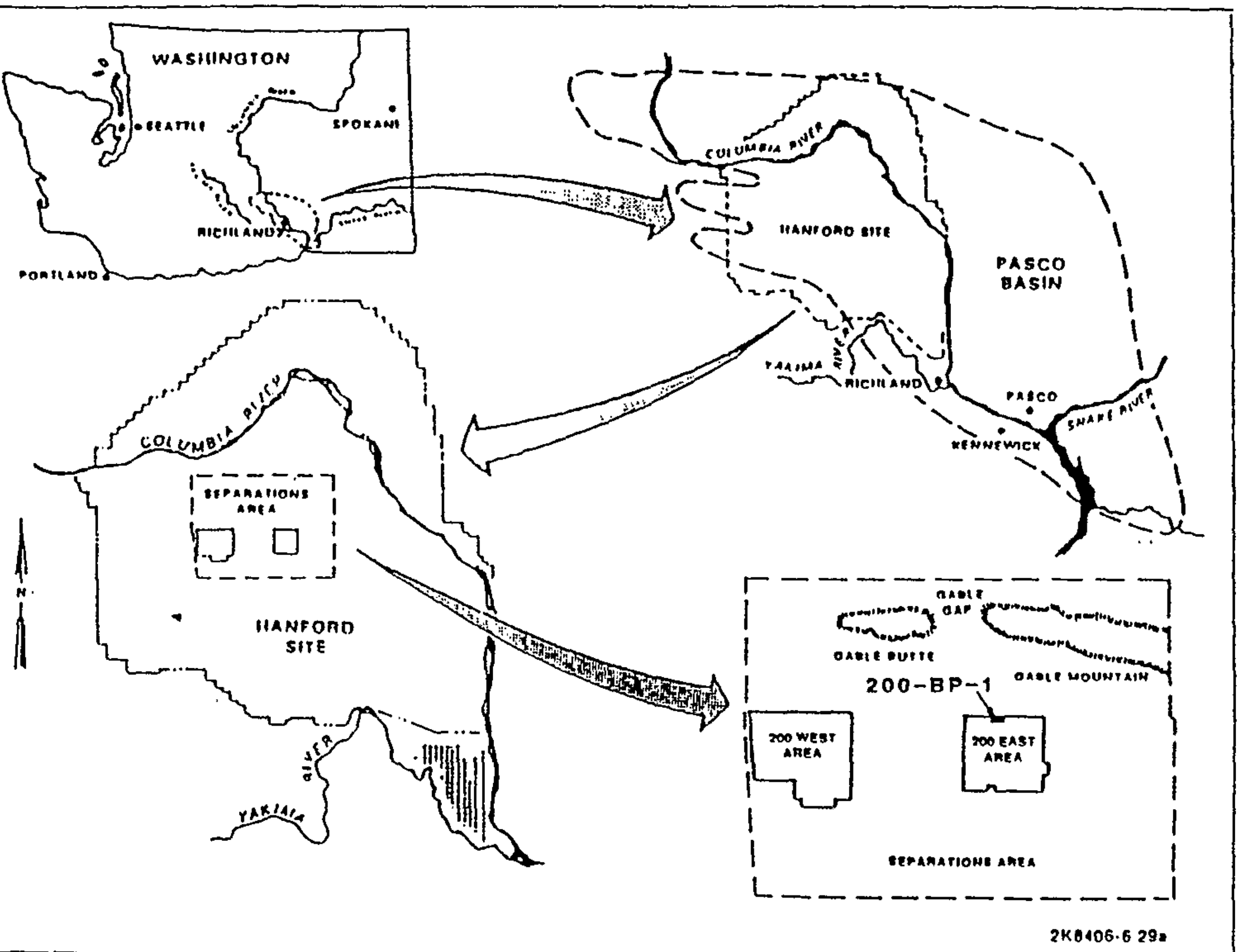
An operational safety limit (OSL) is implemented to limit the pressure of the helium gas allowed in the pipes, which in turn limits the potential release of contaminants to the environment. Dose rates originating from the pipes will be controlled by an appropriate Radiation Work Permit (RWP). Decontamination of equipment used in the leak detection procedure will be performed by established decontamination practices to prevent cross-contamination. Another OSL is implemented that prevents high heat from coming in contact with the pipes, which in turn prevents a potential reaction with ferrocyanide residues that may be present in the pipes. Additional prudent actions are specified in Section 5.3 of this assessment.

2.0 SITE DESCRIPTION

The 200-BP-1 OU encompasses approximately 25 acres and is located along the northern boundary of the 200 East Area on the Hanford Site. The Hanford Site is located in south-central Washington State, approximately 170 mi (273 km) southeast of Seattle and 125 mi (201 km) southwest of Spokane (Figure 2). A complete description of the operable unit can be found in the work plan (DOE-RL 1990).

The underground piping in the 200-BP-1 Operable Unit is buried under approximately 2 to 5 ft (0.6 to 1.5 m) of soil. The location for the leak test on the two 4 in. (10 cm) lines is approximately 400 ft (122 m) east on a perpendicular from the line connecting the 241-BY Tank Farm to cribs 43-49. The approximate location for the 2 in. (5 cm) pipe leak test is at the top of the hill just south of the OU boundary (see Figure 3). The 4 in. (10 cm) pipes have already been excavated where the leak test will occur. Visual inspections have indicated that the pipes are in good condition.

Figure 2. Site Orientation.



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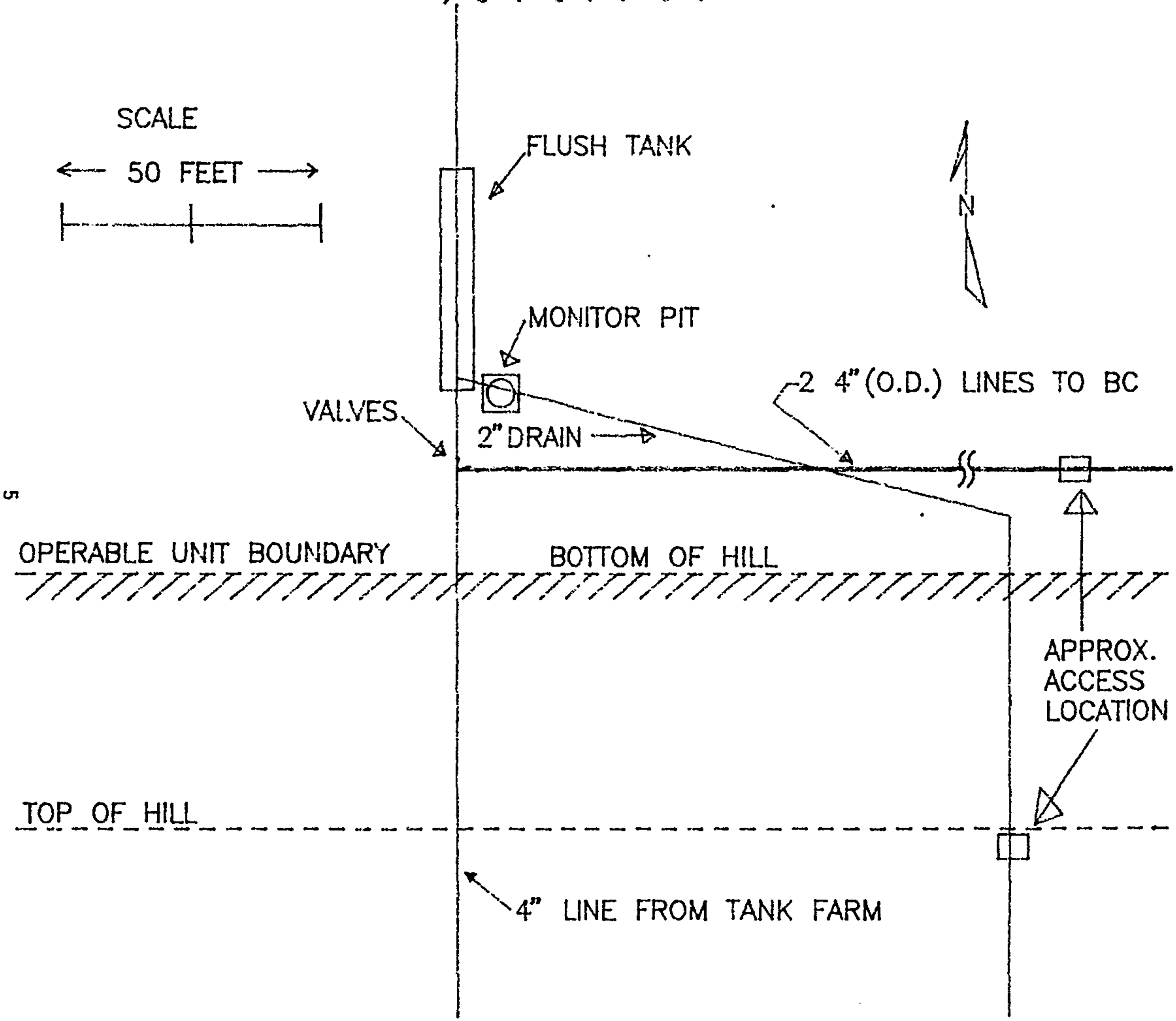

Figure 3. Pipe Configuration and Location of Leak Test on the Two 4 in. Lines.

3.0 WORK DESCRIPTION

Helium tracer gas will be used to perform a leak test on the sections of pipe outlined above. The helium source will be a pressurized helium bottle with attached regulators, gauges and valves. Helium will be admitted into the pipe by way of a T-PLUS[1] coupling or a bolt on Tee with valve. Both methods will minimize contact with the interior of the pipe thereby limiting the avenues for contamination spread. The T-PLUS coupling is bolted (not welded) to the pipe where a charge driven plunger shears the pipe and creates an opening for a new branch (see Attachment B for a description of T-PLUS coupling). No welding will be permitted on any of the pipes due to the potential presence of ferrocyanide compounds inside the pipes.

Two T-PLUS couplings are installed on the pipe a short distance away from each other. One of the couplings is installed to inject foam into the pipe providing a stop and the other is installed to introduce the helium gas. The helium gas is slowly released into the pipeline where it will diffuse through holes and defects. The bolt on Tee with valve (Figure 4) is installed similarly to the T-PLUS except that penetration of the pipe will be made with a drill and plastic containment. Decontamination of equipment will be performed by established decontamination practices. The T-PLUS coupling will be used on the 2 in. (5 cm) line and the Tee with valve will be used on the 4 in. (10 cm) lines. The T-PLUS coupling does provide better containment; however, it is not made in sizes larger than 3 in. (8 cm). Because the two 4 in. (10 cm) lines are 8 in. (20 cm) off-center, they will be tested simultaneously. The 2 in. (5 cm) line will be tested separately. The 2 in. (5 cm) line will be accessed near the top of the slope south of the crib area.

A portable helium detector is used to locate any potential leaks. The detector uses a sensor block that relies on changes in thermal conductivity. A separation column draws in an air sample, and the components are reported as they pass over the sensor. Each component has a unique thermal conductivity, thereby allowing the sensors to be specific to helium. Helium detection is in the range of 0.01 to 1.00 of concentrated helium (100%). Figure 5 shows the migration rate of helium through a variety of soil types.

To locate a leak, ambient air samples are collected by the sampler immediately above the ground surface in 2 ft (0.6 m) increments (Figure 6). Samples are collected above the entire length of the tested pipeline. If helium is detected over a certain portion of the buried pipeline, the leak can be located within 6 in. (15 cm) by collecting several readings in the vicinity where helium was first detected.

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[1]T-PLUS is a registered trademark of Kitz Corporation, Tokyo, Japan.

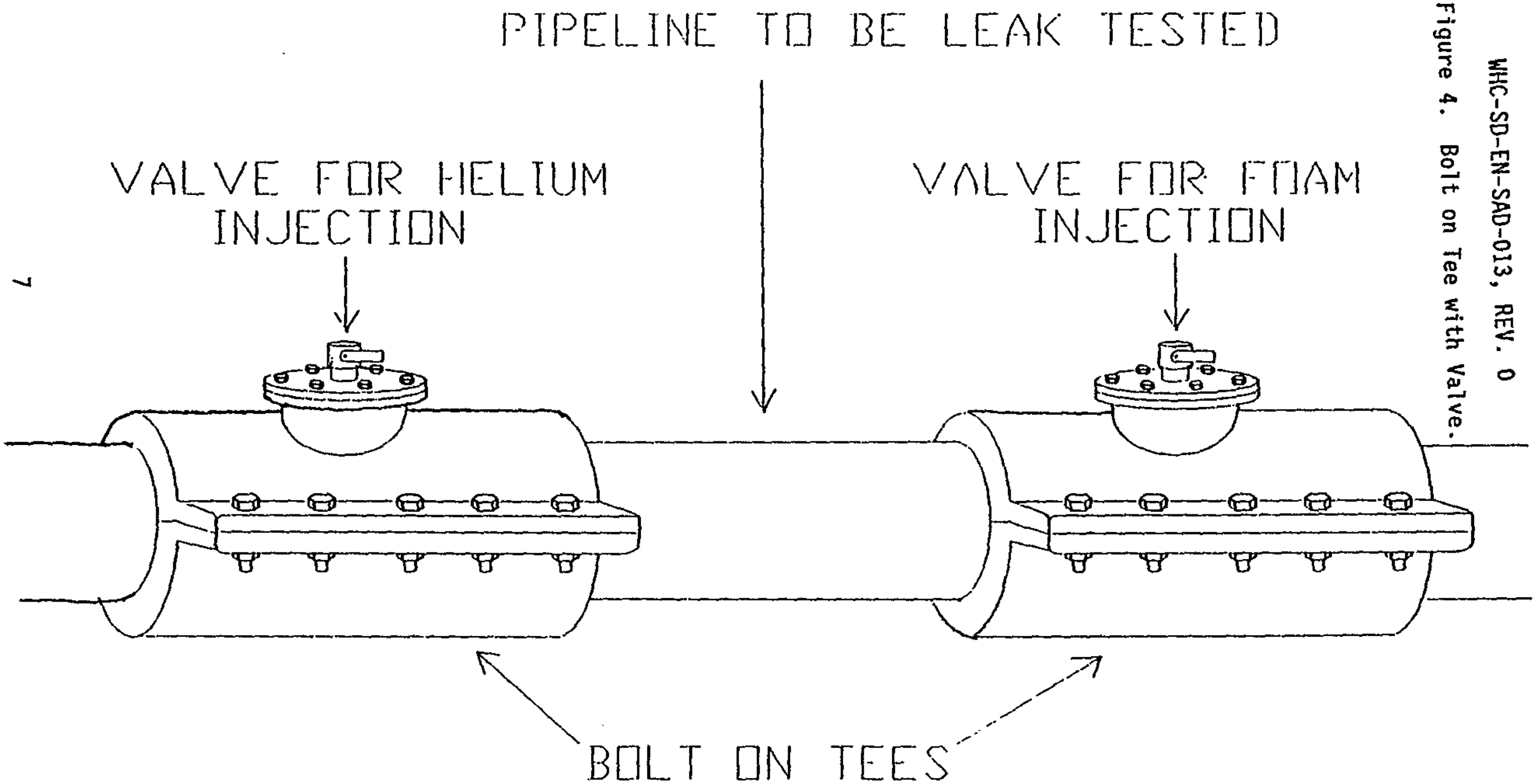


Figure 4. Bolt on Tee with Valve.

Figure 5. Helium Migration Rates in Various Soils.

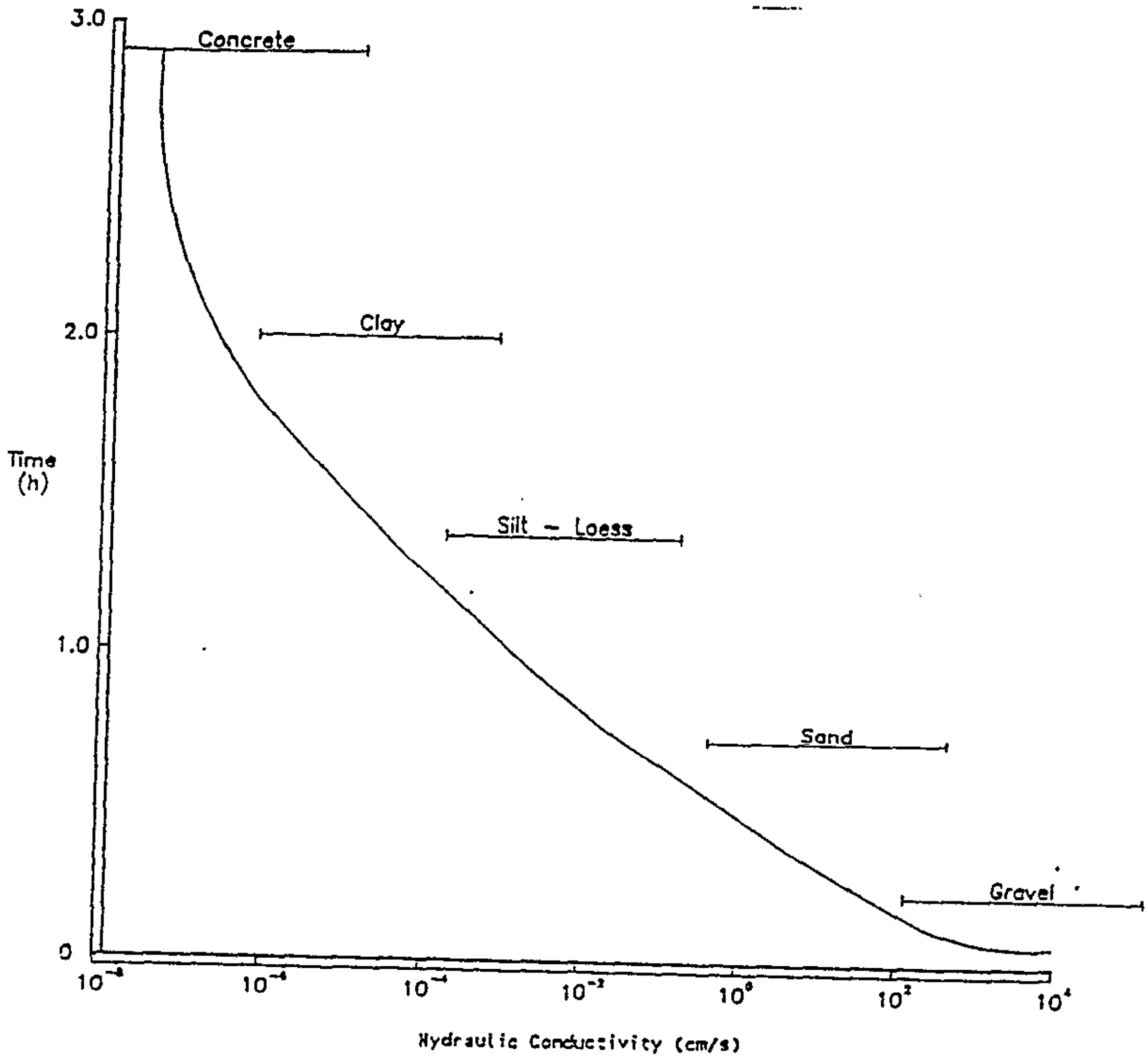
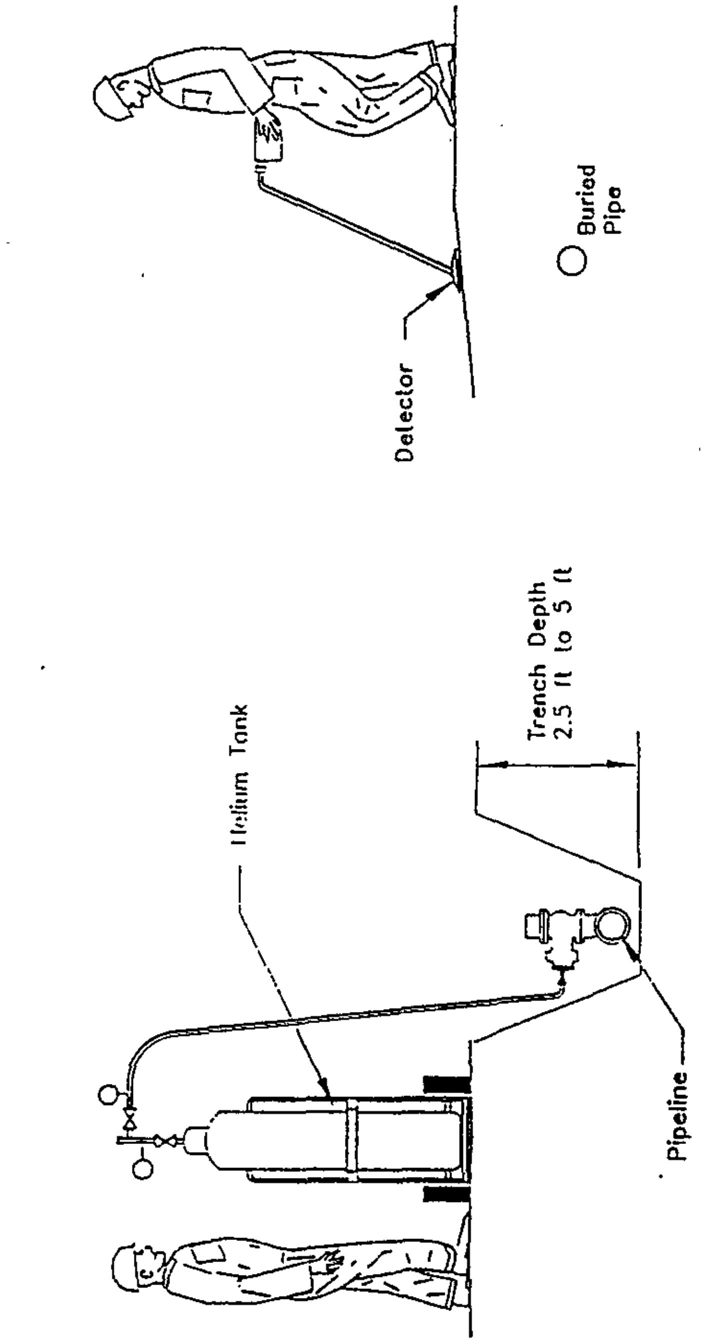


Figure 6. Schematic of T-Plus Valve and Helium Tracer Gas Leak Detection Techniques.



4.0 HAZARDS

An evaluation of the intrinsic hazards associated with the helium leak test was performed. Natural phenomena were considered and dismissed due to the short duration (8 to 12-h) of the leak test activity and the lack of any additional contributions by natural phenomena to the pressure energy already provided by the helium bottle.

The possibility of an explosive event occurring was evaluated based upon the potential compounds of nickel ferrocyanide-nitrate mixtures that may exist in the pipes. Explosive events are not generally observed until temperatures in excess of 340° C (644° F) are reached. An explosive event was dismissed on the basis that such temperatures would not be reached during the leak test. Testing has also proven that nickel ferrocyanide-nitrate mixtures are insensitive to impact, friction, and sparking stresses below 200° C (see Attachment C).

The accident scenarios considered were those that could have a potential for dispersing the contaminants from the pipe interior to the atmosphere. Use of the T-PLUS coupling or the Tee with valve minimizes any contact with the interior of the pipe and therefore limits the avenues for contamination spread. A pressurized spray leak through a hole in the pipe was considered but dismissed because the elevation and configuration of the pipelines did not allow for any liquids to collect inside the pipe. A pressurized release ofthe contaminant residues was considered and determined to be a credible scenario. It was further determined that the two 4 in. (10 cm) lines have potentially higher contamination levels in them than the 2 in. (5 cm) line. Consequently, the evaluation was focused on a pressurized release from one of the 4 in. (10 cm) lines. Attachment A contains the methodology, assumptions, and calculations for the pressurized release scenario.

The release of contaminants at leak points in the underground section of the pipe would not present any hazard consequences due to the barrier provided by the soil column and the inert character of the gases that prevent chemical binding with the contaminants.

A radiation survey has been completed at the leak test location for the two 4 in. (10 cm) pipes. The results show a 40 and 50 mR/h dose rate at contact on the two 4 in. (10 cm) pipes and an approximate whole body dose rate of 15 mrem/h in the immediate vicinity. It should be emphasized that these dose rates are not part of a postulated accident scenario but actually exist.

4.1 HAZARD INVENTORY

The hazard inventories in the pipes consist of the residues left behind from waste transfer activities. The highest inventory is believed to exist in the two 4 in. (10 cm) pipes that transferred waste from the BX/BY Tank Farm to Cribs 216-B-14 through 216-B-19 and Trenches 216-B-20 through 216-B-34; 52, 53a, 53b, 54,56, and 58. It is unknown whether transfer lines were flushed after transfer activities ceased but for assessment purposes, the assumption is that enough material is available in the pipes for 10 mg/m^3 of the material to be entrained in the helium/air mixture. The inventory consists of the total quantity of material that could be released to the atmosphere from a leak in one of the 4 in. (10 cm) pipes under 50 psig. Tables 1 and 2 show the hazard inventory that is available for release in the postulated scenario. Attachment A contains the detailed basis for the inventory.

Table 1. Postulated Quantity of Radioactive Material Released in an Accident Scenario.

Radionuclide	Quantity released (μCi)
^{90}Sr	5.2E-3
^{137}Cs	6.9E-3
^{60}Co	4.0E-6
^{239}Pu	2.2E-5
^{240}Pu	6.0E-6
^{238}U	2.6E-6

Table 2. Postulated Quantity of Chemicals Released in an Accident Scenario.

Chemical	Quantity released (mg)
Sodium	15
Nitrate	35
Sulfate	2.5
Phosphate	2
Ferrocyanide	.1

4.2 RELEASE SCENARIO

Owing to the high diffusion rate of helium, the pipes need not be pressurized in order to detect leaks. But for assessment of worst case hazard consequences, the assumption is that the two 4 in. (10 cm) pipes are accidently pressurized to 50 psig. At or near the coupling locations a release of the pressurized helium-air mixture occurs from one of the two pipes. This causes the contaminants, entrained in the gas, to be spewed out of the pipes and into the atmosphere. The size of the hole through which the gas is released is not specified, but for assessment purposes the release lasts for 2-h.

4.3 SUMMARY OF HAZARD CONSEQUENCES

The two receptors evaluated were the site worker and uninvolved individual. If consequences to the uninvolved individual proved to be a concern, further analysis would be warranted for the offsite receptor. The results of the hazard evaluation are summarized in Tables 3 and 4.

Table 3 shows a comparison between the dose consequences to the two receptors and the dose limits that define a low hazard class activity. The hazard classification determines the level of review and authorization for the proposed activity. The dose consequence to the facility worker is 8E-4 rem compared to the 25 rem limit - a difference of 5 orders of magnitude. The dose consequence to the onsite receptor 330 ft (100 m) downwind is 3E-7 rem compared to the 5 rem limit - a difference of 7 orders of magnitude. Because the potential consequences to the onsite receptor are so low, no further analysis is needed for the offsite receptor.

Table 3. Summary of Radiological Dose Consequences from Postulated Release Scenario.

Receptor	Dose (rem)	Low hazard class limit (rem)
Facility worker	8E-4	25
Onsite 330 ft (100 m)	3E-7	5

Table 4 shows the results for the chemical release. The various sodium compounds that are believed to be in the pipes do not have established exposure limits and therefore do not present a toxic hazard. The methodology and calculations for determining the hazard consequences can be found in Attachment A.

Table 4. Summary of Chemical Air Concentrations from Postulated Release Scenario.

Chemical	Facility worker (mg/m^3)	Onsite 300 ft (100 m) (mg/m^3)
Sodium	3	< .001
Nitrate	6	< .001
Sulfate	.5	< .001
5 Phosphate	.3	< .001
Ferrocyanide	.02	< .001

In the pressurized release scenario only one of the 4 in. (10 cm) pipes is assumed to release the pressurized helium gas. If the pressurized gas in both pipes were released, the resulting consequences would simply be double the consequences for the single pipe. It should be emphasized these results are based on a postulated pressurized release scenario involving 50 psig of helium in the pipes. It is unlikely any pressure buildup will occur in the pipes.

The general whole body dose rate in and around the pipes is approximately 15 mrem/h. A worker standing in the radiation field for 4 min would receive a 1 mrem dose. This illustrates the fact that routine work performed in the 15 mrem/h radiation field contributes to a higher dose consequence than an inhaled dose resulting from a postulated pressurized release accident.

The OSL (Section 5.1) is implemented to limit the amount of pressure buildup allowed in the pipes which in turn limits the potential release of contaminants to the environment. Dose rates originating from the pipes will be controlled by the appropriate RWP.

5.0 LIMITS AND PRUDENT ACTIONS

There is one OSL applied to ensure the validity of the safety assessment and to minimize environmental impact to as low as reasonably achievable. The OSL requires that the pressure in the pipes be limited to prevent any unanticipated release of contaminants.

5.1 OPERATIONAL SAFETY LIMITS

This OSL applies to the pressurization of the pipes with helium tracer gas.

Operational Safety Limit 1

1.0 **Title** - The pressure in the pipes to be leak tested shall not exceed 50 psig.

1.1 **Applicability** - This limit applies to the process of introducing the helium gas into the pipe via the T-PLUS coupling or Tee with valve.

1.2 **Objective** - To minimize potential consequences to the nearest uninvolved and site workers during the leak test.

1.3 **Requirement** - A safety relief valve set at 50 psig or less shall be installed and in service whenever the lines are pressurized.

1.4 **Surveillance** - The responsible operating organization shall verify monitoring that the safety valve is installed as specified in the requirement.

1.5 **Recovery** - In the event that the pressure in the pipe exceeds 50 psig, work shall stop. An evaluation shall be conducted to determine the cause of the noncompliance and approval for restart must be obtained from Safety and Quality Assurance.

1.6 **Basis** - The maximum pressure limit of 50 psig was established for the purpose of minimizing the energy available to disperse contaminant residues from within the pipe systems.

Operational Safety Limit 2

This OSL applies to heating the pipes to temperatures in excess of 340° C (644° F).

1.0 **Title** - The temperatures of the pipes shall not exceed 300° C (572° F).

1.1 **Applicability** - This limit applies to the installation of the pipe valves which will be used for introducing the helium tracer gas.

1.2 **Objective** - To prevent a potential reaction involving ferrocyanide residues that may be present inside the pipes.

1.3 **Requirement** - Activities capable of generating pipe temperatures in excess of 300° C (572° F) at the pipes shall not be permitted. These would include such activities as welding or cutting with a torch.

1.4 **Surveillance** - The responsible operating organization shall verify that welding or cutting with a torch will not be done on the pipes to ensure that temperatures at the pipes do not exceed 300° C (572° F).

1.5 **Recovery** - In the event of a noncompliance, the work shall stop and an evaluation shall be conducted for the noncompliance. Approval for restart must be obtained from Safety and Quality Assurance.

1.6 **Basis** - The limit on pipe temperatures was established for the purpose of preventing a reaction with potential ferrocyanide deposits inside the pipes.

5.2 PRUDENT ACTIONS

Prudent actions are recommendations or suggestions for performing the work in a safe manner. The following is a list of prudent actions.

1. Provide a small inline high-efficiency particulate air filter to prevent the potential escape of contaminants if bleed off of excess pressure is required.

2. Restrict work area access to only those site personnel required for the task.

3. Provide constant Health and Safety monitoring for controlling personnel exposures to direct irradiation.

6.0 REFERENCES

DOE, 1988, *Safety Analysis and Review System*, DOE Order 5481.1B, U.S. Department of Energy, Washington D.C., September 23, 1986.

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ATTACHMENT A
SAFETY EVALUATION, WORST CASE CONSEQUNCES FROM A PRESSURIZED RELEASE INVOLVING A 200-BP-1 WASTE TRANSFER PIPE

INTRODUCTION

Three pipelines in the 200-BP-1 Operable Unit will be leak tested with helium tracer gas. The underground pipelines to be leak tested are described below:

- Two 4 in. (10 cm) lines that run the length (east and west) of the 241-BY Tank Farm approximately 500 ft (152 m) long. The lines were used to transfer waste from the BX/BY Tank Farm to the BC cribs and trenches outside the operable unit (OU).
- A 2 in. (5 cm) dia pipe approximately 200 ft (61 m) long that runs north, northwest, and then north again to the vicinity of the 216-B-43 through 216-B-50 Cribs. This pipe transferred condensates from the tank farm to the cribs.

Liquid wastes disposed at the 200-BP-1 Operable Unit cribs and unplanned releases were the result of the tributyl phosphate extraction processes or in-tank solidification (ITS) processes associated with single-shell tank farm operations. The waste was scavenged by potassium ferrocyanide to precipitate cesium. The supernatant was decanted to cribs in the OU. The ITS process heated tank waste and in the process, generated condensates. These condensates were also disposed in cribs at the 200-BP-1 Operable Unit.

PURPOSE OF THE ANALYSIS

The purpose of this analysis is to do a preliminary safety evaluation of the helium leak test to be done on the pipes mentioned above. This activity is transitory in nature (one time only) and the likelihood of a significant release is considered to be very low. Analysis of a hypothetical release reveals that the only impact would be to the facility worker.

BASIS OF THE ANALYSIS

The waste from BX/BY Tank Farm that was transferred through the two 4 in. (10 cm) lines contained higher concentrations of chemicals and radionuclides and is potentially more hazardous than the condensate transferred through the one 2 in. (5 cm) line. The 4 in. (10 cm) line, which is larger in diameter and length, has more surface area to retain contaminants. It is concluded that the consequences from a break in the 2 in. (5 cm) line would be bounded by the consequences resulting from a break in the 4 in. (10 cm) line.

INVENTORY BASIS

To determine the inventory basis, the total mass of waste that was transferred through the pipes was compiled (WHC 1991). The cribs and trenches that were serviced by the two 4 in. (10 cm) lines are outside the OU and consist of Cribs 216-B-14 through 216-B-19 and Trenches 216-B-20 through 216-B-34; 52, 53a, 53b, 54, 56, and 58. The total mass of chemicals is listed below.

Chemicals	Mass (x 10^7kg
Sodium	1.036
Nitrate	2.390
Sulfate	.167
Phosphate	.1186
Ferrocyanide	.00642
Total Mass	3.71802×10^7 kg

The total mass of radionuclides that was transferred through the pipes is equal to the sum of the total activity of each radionuclide transferred and divided by its respective specific activity. The total activity and corresponding mass is given below. The activities are decayed through April 1, 1986 (WHC 1991).

Radionuclides	Total Activity (Ci)		Specific Activity Ci/g		Mass (g)
^{90}Sr	3.5724E+3	÷	1.41E+2	=	2.533E+1
^{137}Cs	4.6973E+3	÷	8.70E+1	=	5.400E+1
^{60}Co	2.7568E 0	÷	1.13E+3	=	2.440E-3
^{239}Pu	1.5338E+1	÷	6.13E-2	=	2.502E+1
^{240}Pu	4.1103E 0	÷	2.27E-1	=	1.810E+1
^{238}U	1.8085E 0	÷	3.33E-7	=	5.430E+6

Total mass of radionuclides: 5.430122452×10^6 g
or 5.430122452×10^3 kg

The total mass of chemical and radiological components combined is equal to

$$3.71802 \times 10^7 \text{ kg} + 5.430122452 \times 10^3 \text{ kg} = 3.718563012 \times 10^7 \text{ kg}$$

The fractional composition of the total mass for each component is given below.

Component	Fraction
Sodium	.27860
Nitrate	.642721
Sulfate	.0449098
Phosphate	.031894
Ferrocyanide	.00172647
^{90}Sr	6.81177E-10
^{137}Cs	1.45217E-9
^{60}Co	6.56167E-14
^{239}Pu	6.728405E-9
^{240}Pu	4.8674716E-10
^{238}U	1.460241E-4

LEAK TEST RELEASE SCENARIO

Owing to the high diffusion rate of helium, the pipes need not be highly pressurized in order to make it possible to detect leaks. For assessment of worst case hazard consequences, it is assumed that the two 4 in. (10 cm) pipes are accidently pressurized to 50 psig. At or near the coupling locations, a release of the pressurized helium-air mixture occurs from one of the two pipes. This causes the contaminants, entrained in the gas, to be spewed out of the pipes and into the atmosphere. The size of the hole through which the gas is released is not specified, but for assessment purposes the release lasts for 2-h.

ANALYSIS OF SCENARIO

Determination of Pipe Volume

dia = 4 in. x 2.54 cm/in. = 10.16 cm

length = 500 ft x 12 in/ft x 2.54 cm/in = 1.524E+4 cm

volume = $(10.16)^2 \times \pi/4 \times$ 1.524E+4 = 1.2356E+6 cm^3 or 1.2356E+3 liters or 1.2356 m^3

Assumptions

- The helium/gas behaves as an ideal gas according to the relationship

  $P_1V_1 = P_2V_2$ where P = pressure in KPa and V = volume in m^3

- The release occurs from a hole of unknown dia in the pipe, at or near the coupling location.

- The release lasts for 2-h, at which time the pressure in the pipe drops to one atm or 14.7 psia.

- The released helium/air mixture, when at atmospheric pressure, is capable of supporting 10 mg of particulate per m^3. This assumption is conservative when considering the high probability that contaminants are in the form of a salt cake or thin residue inside the pipe and not readily dispersible (i.e., sodium nitrate, sodium sulphate, etc.).

- The particulate released is made up of respirable size particles.

Known

- Atm press. 14.7 psi ≈ 100 KPa

- The pipe is pressurized to 50 psig or 64.7 psia (440 Kpa)

- The pipe volume is 1.2356 m^3

Calculations

$$V_2 = P_1V_1 \div P_2$$

$$V_2 = (440)(1.2356) \div 100 = 5.437\ m^3$$

The theoretical maximum total mass of contaminants released is:

$$5.437\ m^3 \times .01 g/m^3 = .05437\ g$$

Each component of the mass released is assumed to have the same fractional composition as the total mass transferred through the pipe.

Mass of Each Component Released

Component	Fraction		Mass in Grams		
Sodium	.27860	x	.05437	=	.0151475
Nitrate	.642721	x	.05437	=	.0349447
Sulfate	.0449098	x	.05437	=	.00244174
Phosphate	.031894	x	.05437	=	.00173408
Ferrocyanide	.00172647	x	.05437	=	.00009386
^{90}Sr	6.81177E-10	x	.05437	=	3.703559349E-11
^{137}Cs	1.45217E-9	x	.05437	=	7.89544829E-11
^{60}Co	6.56167E-14	x	.05437	=	3.567579979E-15
^{239}Pu	6.728405E-9	x	.05437	=	3.658233799E-10
^{240}Pu	4.8674716E-10	x	.05437	=	2.646444309E-11
^{238}U	1.460241E-4	x	.05437	=	7.939330317E-6

The activity that is released can be found by multiplying the mass of the radionuclide times its respective specific activity:

Radionuclide	Mass (g)		SpAct. (μCi/g)		Activity (μCi)
^{90}Sr	3.703559E-11	x	1.41E+8	=	5.2220E-3
^{137}Cs	7.895448E-11	x	8.70E+7	=	6.8690E-3
^{60}Co	3.567580E-15	x	1.13E+9	=	4.0314E-6
^{239}Pu	3.658234E-10	x	6.13E+4	=	2.2425E-5
^{240}Pu	2.646444E-11	x	2.27E+5	=	6.0074E-6
^{238}U	7.939330E-6	x	3.33E-1	=	2.6438E-6

The assumption is made that the pressurized volume of helium/air mixture is released through a hole of some kind. The size of hole from which the gas escapes is unknown, but for purposes of this evaluation the gas is assumed to escape over a 2-h period.

RADIOLOGICAL RESULTS

To determine consequences to the receptor (an onsite individual at 330 ft [100 m]) the activity released during the postulated scenario is divided by

7,200 s to obtain a release rate. The release rate is then multiplied by a dispersion factor for a distance of 330 ft (100 m). The dispersion factor in this case is 2.77E-8 cm^3/s (XQ.EXE DOS program). The results are listed below.

Radionuclide	(µCi)		Seconds		(µCi/s)		X/Q s/cm^3		µCi/cm^3
^{90}Sr	5.2220E-3	÷	7,200	=	7.2528E-7	x	2.77E-8	=	2.0E-14
^{137}Cs	6.8690E-3	÷	7,200	=	9.5403E-7	x	2.77E-8	=	2.6E-14
^{60}Co	4.0314E-6	÷	7,200	=	5.5992E-10	x	2.77E-8	=	1.5E-17
^{239}Pu	2.2425E-5	÷	7,200	=	3.1146E-9	x	2.77E-8	=	8.6E-17
^{240}Pu	6.0074E-6	÷	7,200	=	8.3436E-10	x	2.77E-8	=	2.3E-17
^{238}U	2.6438E-6	÷	7,200	=	3.6719E-10	x	2.77E-8	=	1.0E-17

Breathing one derived air concentration (DAC) for 2,000-h gives an individual a 5 rem effective dose equivalent (EDE) (WHC 1988a). Breathing one DAC for 2-h gives an individual 2.0/2,000 x 5 rem or 0.005 rem.

The concentrations at 330 ft (100 m) are compared with the DAC for the respective radionuclides. Fractions of the DAC are then calculated, summed, and multiplied by .005 rem to determine the consequences to the receptor.

Radionuclide	Concentration (µCi/cm^3)		DAC (µCi/cm^3)		Fraction
^{90}Sr	2.0E-14	÷	2.0E-9	=	1.0E-5
^{137}Cs	2.6E-14	÷	7.0E-8	=	3.7E-7
^{60}Co	1.5E-17	÷	1.0E-8	=	1.5E-9
^{239}Pu	8.6E-17	÷	2.0E-12	=	4.3E-5
^{240}Pu	2.3E-17	÷	2.0E-12	=	1.2E-5
^{238}U	1.0E-17	÷	2.0E-11	=	5.0E-7
			Total		6.6E-5

Multiplying the DAC fraction by .005 rem gives an EDE of 3.3E-7 rem or 0.00033 mrem to the onsite receptor. The upper radiological limit that defines low hazard class for the onsite receptor is 5 rem (WHC 1988b). According to the postulated scenario, the consequences to the onsite receptor are 7 orders of magnitude below the low hazard class limit. Consequently, the calculated resultant exposure to the onsite receptor is negligible or insignificant.

CHEMICAL RESULTS

The same scenario used for the radiological components is employed to determine air concentrations of the chemicals at 330 ft (100 m).

Chemical	Mass (mg)		Seconds		mg/s		X/Q		mg/m^3
Sodium	15.15	÷	7,200	=	.00210	x	2.77E-2	=	<.001
Nitrate	34.94	÷	7,200	=	.00485	x	2.77E-2	=	<.001
Sulfate	2.44	÷	7,200	=	.00033	x	2.77E-2	=	<.001
Phosphate	1.73	÷	7,200	=	.00024	x	2.77E-2	=	<.001
Ferrocyanide	.09	÷	7,200	=	.00001	x	2.77E-2	=	<.001

The assumption is made that the chemical anions listed above (i.e., nitrate, sulfate, phosphate, and ferrocyanide) have formed compounds with the cation sodium. These chemical compounds are of very low order of toxicity, and can therefore be considered nonhazardous. The toxicological consequences to the onsite receptor are considered to be negligible.

INSTANTANEOUS RELEASE AND CONSEQUENCE TO SITE WORKER

Radiological Consequence Analysis

A scenario is postulated in which one of the valve installations fails in some way, resulting in an instantaneous release of the pressurized helium/air mixture to the atmosphere. The purpose here is to determine an upper boundary for consequences to the facility worker.

Assumptions

- The release is instantaneous and forms a plume with a volume equal to 5.437 m^3 of helium/air mixture that contains .05437 g of contaminants.

It is assumed for assessment purposes that the plume has a cross sectional area of 1 m^2. Assuming a wind speed of 1 m/s, it would take 5.437 or 6 s before the plume would completely pass. The assumption is that the maximum time of exposure for a facility worker is 6 s.

This is the maximum time of exposure at the concentration existing at the point of release. Exposure time increases downwind as cloud gets bigger while concentration gets smaller.

Radionuclide Concentrations

Radionuclide	Activity (μCi)		Volume cm^3		Concentrations $\mu Ci/cm^3$
^{90}Sr	5.2220E-3	÷	5.437E+6	=	9.60E-10
^{137}Cs	6.8690E-3	÷	5.437E+6	=	1.26E-9
^{60}Co	4.0314E-6	÷	5.437E+6	=	7.41E-13
^{239}Pu	2.2425E-5	÷	5.437E+6	=	4.12E-12
^{240}Pu	6.0074E-6	÷	5.437E+6	=	1.10E-12
^{238}U	2.6438E-6	÷	5.437E+6	=	4.86E-13

Breathing one DAC for 6 s produces an EDE of

$$0.1/2000 \times 5 \text{ rem} = 2.5E-4 \text{ rem}$$

The above concentrations are compared with the DAC for the respective radionuclides. Fractions of the DAC are then calculated, summed, and multiplied by 2.5E-4 rem to determine the consequence to the facility worker.

Radionuclide	Concentration ($\mu Ci/cm^3$)		DAC ($\mu Ci/cm^3$)		Fraction
^{90}Sr	9.60E-10	÷	2.0E-9	=	4.8E-1
^{137}Cs	1.26E-9	÷	7.0E-8	=	1.8E-2
^{60}Co	7.41E-13	÷	1.0E-8	=	7.4E-5
^{239}Pu	4.12E-12	÷	2.0E-12	=	2.1E 0
^{240}Pu	1.10E-12	÷	2.0E-12	=	5.5E-1
^{238}U	4.86E-13	÷	2.0E-11	=	2.43E-2
			Total		3.2E 0

Multiplying the DAC fraction by 2.5E-4 rem gives an EDE of 8.0E-4 rem or .8 mrem to the facility worker. The upper radiological limit that defines low hazard class for the facility worker is 25 rem (WHC 1990a). According to the postulated scenario, the estimated maximum consequences to the facility worker are 5 orders of magnitude below the low hazard class radiological limit. Therefore, this scenario is only an ALARA issue.

Chemical Consequence Analysis

The same scenario used for the radiological components is employed to determine air concentrations of chemicals at the site.

Chemical	Mass (mg)		M^3		mg/m^3
Sodium	15.15	÷	5.437	=	2.8
Nitrate	34.94	÷	5.437	=	6.4
Sulfate	2.44	÷	5.437	=	.45
Phosphate	1.73	÷	5.437	=	.32
Ferrocyanide	.09	÷	5.437	=	.02

As mentioned earlier, sodium nitrate, sodium sulfate, sodium phosphate, and sodium ferrocyanide are of a very low order of toxicity. According to the scenario, the facility worker will only be exposed for 6 s to any of the above concentrations. The consequences to the facility worker are considered to be insignificant.

CONCLUSION

The conclusion arrived at in this evaluation is that hazard consequences to the onsite and offsite receptors are negligible. Based on the limited duration of the activity (8 to 12-h) and the potential for only a small amount of material released, the exposure to the site worker will be an ALARA issue. Direct irradiation has been measured at 40 mR/h and 50 mR/h at contact for both 4 in. (10 cm) pipes. Whole body dose rates in the immediate vicinity of the pipes are around 15 mrem/h. A worker standing in the 15 mrem/h field for 4 min would receive a dose comparable to the inhaled dose from the postulated release.

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The conclusion arrived at in this evaluation is that hazard consequences to the onsite and offsite receptors are negligible. Based on the limited duration of the activity (8 to 12-h) and the potential for only a small amount of material released, the exposure to the site worker will be an ALARA issue. Direct irradiation has been measured at 40 mR/h and 50 mR/h at contact for both 4 in. (10 cm) pipes. Whole body dose rates in the immediate vicinity of the pipes are around 15 mrem/h. A worker standing in the 15 mrem/h field for 4 min would receive a dose comparable to the inhaled dose from the postulated release.

REFERENCES

WHC, 1988a, *Radiation Protection Manual*, WHC-CM-4-10, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988b, *Nonreactor Facility Safety Analysis Manual*, WHC-CM-4-46, Westinghouse Hanford Company.

WHC, 1990, *Implementation Guide for Hazard Documentation*, WHC-SD-GN-ER-301, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991, *WIDS Database Field definitions and Data*, WHC-MR-0056, Rev. 1, Waste Information Data System, Westinghouse Hanford Company, Richland, Washington.

Calculations done by [signature] Date 7/28/92

Second check done by [signature] Date 7/28/92

ATTACHMENT B

DESCRIPTION OF T-PLUS COUPLING

T-PLUS™

UL LISTED

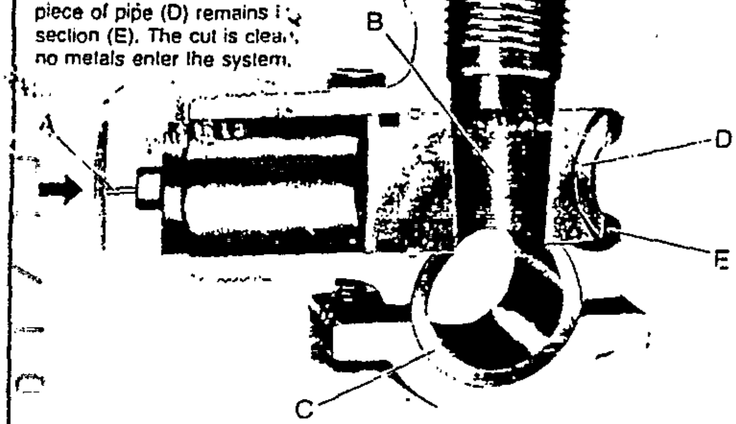
Installation Guide

T-PLUS is the first branch fitting which also can be installed on a pressurized pipe without interruption of the flow.
It is designed only for use on non-deformed steel pipe conforming to ISO 65-1973 Medium Series ASTM-120, ANSI B 125.2 Schedule 40, BS 1387.
(Note, do not use on copper tube, PVC pipe or other pipe not conforming to above specification.)

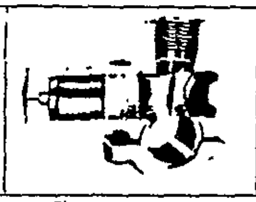
Read these instructions before installing coupling.

This is how T-PLUS™ works

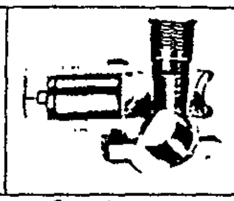
Place the activating spoon in the hole in the cap (A), and hit the pin with a sharp hammer blow. A driving charge propels the plunger (B) forward shearing the pipe (C) creating the opening to the new branch. The cut-off piece of pipe (D) remains in section (E). The cut is clean, no metals enter the system.



Before activation.



Plunger shearing pipe



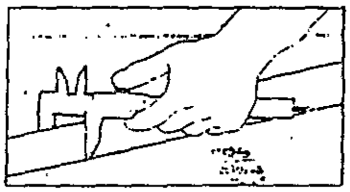
Connection complete

Important Note

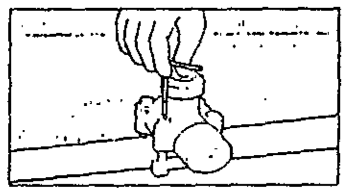
The T-PLUS coupling shall only be activated when mounted on proper steel pipe of proper dimension and quality. NOTE! This coupling must be handled with care, keep all foreign objects out of the branch opening (i.e. fingers, tools, etc.). Accidental activation could result in personal injury.

1 It is designed to be installed by professionals to connect pipe lines carrying cold or hot water, air or other non-combustible neutral fluids. T-PLUS is not to be used in flammable or explosive atmospheres.

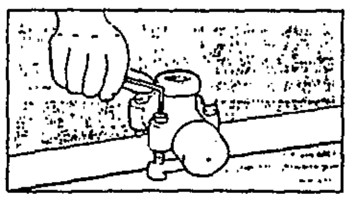
2 Specifications:
Branch threads – NPT
Norminal operating pressure – 150psi
Maximum working pressure – 300psi, water, air
Maximum working temperature – 300°F, 150°C



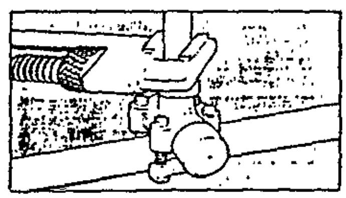
1 Check to make sure that the pipe size is correct. Either oversize or undersize will not make a secure joint. Check to insure all rust and scale is removed from outside of pipe.



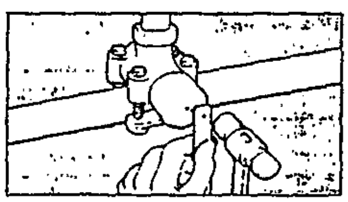
2 Place the T-PLUS body portion on the pipe with the gasket between body and pipe. Turn the coupling so the branch is in desired direction. Place the screws through the body ears and hand tighten all four screws into the clamp.



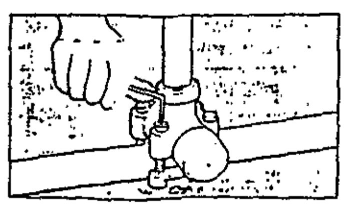
3 Check to make sure that the gasket is in the proper position. Tighten the screws alternately with the hex key until all are thoroughly and equally tight. Note! Loose screws will allow slight motion and will cause T-PLUS to malfunction.



4 Use pipe dope or teflon tape when making the branch pipe connection. IMPORTANT! If the pipe is under pressure, the branch must be completed or valved as flow will start immediately when T-PLUS is activated.



5 Place the activating spoon in the hole in the cap and strike the spoon with a sharp, distinct hammer blow. NOTE! Only one sharp hammer blow is required to activate T-PLUS. An improper blow will ruin the T-PLUS ignition.
In the connecting branch there must not be any fluid whatsoever before the connecting operation is finished.



6 After activating, retighten immediately all four screws to secure proper working conditions.

T-PLUS Limited Warranty

All parts of the T-PLUS coupling are warranted to the original end-use purchaser to be free from defects in material and workmanship for a period of two (2) years from the date of purchase as shown on purchaser's receipt.
The distributor will replace free of charge, during the warranty period any T-PLUS couplings which prove defective in material and/or workmanship under normal installation, use and service. Replacement T-PLUS couplings can be obtained from your local dealer or distributor listed in the telephone directory or by returning the coupling to us.
This warranty is limited to defective parts replacement only. Labour charges and/or damage incurred in installation repair or replacement as well as incidental and consequential damages connected therewith are excluded. Any damage to this product as a result of misuse, neglect, accident, improper installation or any use in violation of instructions furnished by us will void the warranty.

KITZ CORPORATION
3-17-9 Minami-Aoyama, Minato-ku, Tokyo 107, Japan.

ATTACHMENT C

EVALUATION OF FERROCYANIDE HAZARD

DON'T SAY IT --- Write It!

DATE: March 19, 1991

TO: David Harrold N1-75

FROM: Ed Thornton H4-55
Telephone: 6-6470

SUBJECT: Evaluation of Explosive Hazards Associated with Hot Tapping 200-BP-1 Lines

I briefly examined the material that you provided on the use of the hot tap method for testing the 200-BP-1 pipelines. The principal issue here is whether the hot tap method may pose an explosive hazard, since nickel ferrocyanide and nitrate mixtures of salts may exist in the pipelines.

The explosive hazard associated with employment of the hot tap method is considered to be minimal, since very little heat would be generated by drilling into the pipe. Testing activities conducted by Pacific Northwest Laboratories and Los Alamos National Laboratory indicate that explosive events are not generally observed until temperatures in excess of 340°C are attained. Testing also indicated that the nickel ferrocyanide-nitrate mixtures are insensitive to impact, friction, and sparking stresses.

The danger associated with welding is considered to be somewhat greater, since relatively high temperatures would probably develop on the inside of the pipe. Thus, it is suggested that an alternative to welding the split tee to the pipe should be investigated.

Date Received: 7/30/92	INFORMATION RELEASE REQUEST	Reference: WHC-CM-3-4

Complete for all Types of Release

Purpose

- [] Speech or Presentation
  - [] Full Paper
  - [] Summary
  - [] Abstract
  - [] Visual Aid

  (Check only one suffix)
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- [] Poster Session
- [] Videotape
- [] Reference
- [x] Technical Report
- [] Thesis or Dissertation
- [] Manual
- [] Brochure/Flier
- [] Software/Database
- [] Controlled Document
- [] Other

ID Number (include revision, volume, etc.)
WHC-SD-EN-SAD-013, REV. 0

List attachments.
Attachments A, B, and C

Date Release Required
July 28, 1992

Title Safety Assessment for Helium Gas Leak Detection in 200-BP-1 Waste Effluent Pipes

Unclassified Category
UC-

Impact Level 2 ESQ

New or novel (patentable) subject matter? [X] No [] Yes
If "Yes", has disclosure been submitted by WHC or other company?
[] No [] Yes Disclosure No(s).

Information received from others in confidence, such as proprietary data, trade secrets, and/or inventions?
[X] No [] Yes (Identify)

Copyrights? [X] No [] Yes
If "Yes", has written permission been granted?
[] No [] Yes (Attach Permission)

Trademarks?
[] No [X] Yes (Identify) T-PLUS is a registered trademark of Kitz Corporation, Tokyo, Japan.

Complete for Speech or Presentation

Title of Conference or Meeting

Group or Society Sponsoring

Date(s) of Conference or Meeting

City/State

Will proceedings be published? [] Yes [] No
Will material be handed out? [] Yes [] No

Title of Journal

CHECKLIST FOR SIGNATORIES

Review Required per WHC-CM-3-4	Yes	No	Reviewer - Signature Indicates Approval Name (printed)	Signature	Date
Classification/Unclassified Controlled Nuclear Information	[]	[x]			
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Applied Technology/Export Controlled Information or International Program	[]	[x]			
WHC Program/Project	[]	[x]			
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Publication Services	[x]	[]	Steven M. Neale	Steven M. Neale	8/5/92
Other Program/Project	[]	[x]			

Information conforms to all applicable requirements. The above information is certified to be correct.

	Yes	No
References Available to Intended Audience	[x]	[]
Transmit to DOE-HQ/Office of Scientific and Technical Information	[]	[x]

Author/Requestor (Printed/Signature) Date
D.L. Harrold D. L. Harrold 7/29/92

Intended Audience
[] Internal [] Sponsor [X] External

Responsible Manager (Printed/Signature) Date
N.R. Kerr NK 7/29/92

INFORMATION RELEASE ADMINISTRATION APPROVAL STAMP

Stamp is required before release. Release is contingent upon resolution of mandatory comments.

APPROVED FOR RELEASE
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